

## CLAIMS

What is claimed is:

1. A method, comprising producing an expanded based carbon containing tip including:  
fabricating a carbon containing expanded base on a substrate; and then  
fabricating a carbon containing extension on the expanded base.
2. The method of claim 1, wherein fabricating said carbon containing extension includes  
fabricating said carbon containing extension on an apex of said carbon containing expanded  
base.
3. The method of claim 1, further comprising providing a catalyst that is coupled to said  
substrate before fabricating said carbon containing expanded base.
4. The method of claim 3, wherein the catalyst includes at least one member selected  
from the group consisting of nickel, iron and cobalt.
5. The method of claim 3, wherein providing a catalyst includes coating said substrate  
with an electron beam resist, patterning said electron beam resist, depositing a buffer layer on  
said substrate, depositing said catalyst on said buffer layer, and removing said electron beam  
resist.
6. The method of claim 3, further comprising heating said catalyst to form multiple  
catalyst droplets.
7. The method of claim 1, wherein fabricating said carbon containing expanded base  
includes providing a carbon source gas and an etchant gas.
8. The method of claim 7, wherein fabricating includes chemical vapor deposition.

9. The method of claim 8, wherein fabricating includes plasma enhanced chemical vapor deposition.
10. The method of claim 9, wherein fabrication includes heating said substrate with a cathode to which said substrate is coupled.
11. The method of claim 9, wherein fabricating includes at least one technique selected from the group consisting of dc glow discharge plasma enhanced chemical vapor deposition, radio-frequency plasma enhanced chemical vapor deposition and microwave plasma enhanced chemical vapor deposition.
12. The method of claim 7, wherein the carbon source gas includes acetylene and the etchant gas includes ammonia.
13. The method of claim 1, further comprising transitioning from fabricating said carbon containing expanded base to fabricating said carbon containing extension.
14. The method of claim 13, wherein transitioning includes reducing the ratio of carbon source gas to etchant to effect a transition from expanded base growth to extension growth.
15. The method of claim 13, wherein transitioning includes lowering a process pressure to effect a transition from expanded base growth to extension growth.
16. The method of claim 13, wherein transitioning includes changing a plasma power to effect a transition from expanded base growth to extension growth.
17. The method of claim 13, wherein transitioning includes changing a discharge voltage to effect a transition from expanded base growth to extension growth.
18. The method of claim 13, wherein transitioning includes changing a process

temperature to effect a transition from expanded base growth to extension growth.

19. An electron emitter made by the method of claim 1.

20. An apparatus, comprising:

a carbon containing expanded base coupled to a substrate; and

a carbon containing extension coupled to said carbon containing expanded base.

21. The apparatus of claim 20, wherein said carbon containing expanded base is substantially cylindrically symmetrical and said carbon containing extension is substantially cylindrically symmetrical.

22. The apparatus of claim 21, wherein said carbon containing expanded base is substantially conical.

23. The apparatus of claim 22, wherein said carbon containing expanded base define a substantially solid cone.

24. The apparatus of claim 22, wherein said carbon containing expanded base defines a substantially hollow funnel.

25. The apparatus of claim 21, wherein said carbon containing extension is substantially cylindrical.

26. The apparatus of claim 25, wherein said carbon containing extension defines a substantially solid rod.

27. The apparatus of claim 25, wherein said carbon containing extension defines a substantially hollow tube.

28. The apparatus of claim 20, further comprising another carbon containing expanded base coupled to said substrate; and another carbon containing extension coupled to the another carbon containing expanded base.

29. An electron emitter, comprising the apparatus of claim 20.